# THE SHEEP: ITS EXTERNAL AND INTERNAL ORGANISATION

AN ILLUSTRATED REPRESENTATION AND BRIEF DESCRIPTION

REVISED AND EDITED BY

PROFESSOR G. T. BROWN, C.B.

BY

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*MUNICIPAL VETERINARY SURGEON TO THE DISTRICT OF FORTH.*

THREE SHILLINGS & SIXPENCE NETT:

PRINTED IN GERMANY

GEORGE PHILIP & SON, LONDON: 32, FLEET STREET, E.C.; LIVERPOOL: 45 TO 51 SOUTH CASTLE STREET.

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# THE SHEEP.

The Sheep (Ovis, *L.*) belongs to the division *Vertebrata*, class *Mammalia*, order *Ruminantia*, and family of the Cloven-footed Mammalians. They are elegant, agile animals, with a covering of wool. They have slender bodies, head narrowing very much towards the front, and fairly large eyes and ears. In the horned breeds, the horns are angular trilateral, with protuberances running obliquely; have a side direction, are spirally shaped and twisted, and rest on a bony protuberance, which has the same direction as the horn, but is much shorter than this latter. As a rule horned sheep only possess one pair of horns, though there are some with four or even more horns; these, however, must be considered as accidental formations only. Hornless sheep have thus on each side either small osseous bosses, or shallow hollows on the frontal bones, as indications of the horn-roots (or lumps). Hornless rams occasionally exhibit on the suture of the head a short core of horn, which is provided on the outside with laminæ of horn. Sheep possess the so-called lachrymal pits, which lie in front of the anterior edge of the orbit, towards the inner corner of the eye. The outer skin forms a depression (lachrymal furrow) over the lachrymal pit; but this, however, has nothing to do with the lachrymal secretion. The closely-allied goats, as well as several kinds of wild sheep, lack the lachrymal pits, and therefore the furrow likewise. The upper lip is cleft and covered with delicate hairs. The nose is rather long. The ears generally stand apart, but occasionally they hang down; short ears are also carried directed upwards. The sheep has 24 molars in the upper and lower jaw, and 8 incisors, which latter are in the lower jaw only. Instead of incisors, the upper jaw has a fibrous pad. The body of the sheep is covered with hair and wool. The hair is either a short—generally reddish or greyish brown, partly whitish—surface hair, or the body is furnished with bristles, mingled with downy hair; or it has woolly hair, while the face and legs are covered with downy and surface hairs. In this last particular the Merino sheep forms an exception, its face and feet being for the most part thickly covered with wool. Bristly hairs, downy hairs, and woolly hairs are generally of a white colour; but there are also grey, brown, and black hairs of this kind. The changing of the coat occurs regularly in wild sheep, and irregularly in the domestic animals.

As in the consideration of the various breeds the character of the hairy coat, and of the wool of the sheep, must often be mentioned, a short description may be given.

The hair consists of three layers—the cortical substance, medullary matter, and the cuticle. The first-named forms the chief part of the hair; it is the middle layer enclosing the medullary matter, while the

cuticle forms a covering over the cortical substance of small laminæ, which either lie close together or overlap like roofing-tiles, thus giving a jagged appearance to the edge of the hair. There may be descried further, in that portion of the hair sticking into the skin, the capillary bulb or root, and, lying outside this, the capillary shaft. The following groupings are here distinguished :—

1. Antennæ-like hairs, which stand singly on the lips and eye-lids, &c.
2. Stubby hairs, the short erect hairs lying close together, which in other animals form the true coat, but which in the sheep only cover the face, ears, and legs.
3. Bristly hairs, which form, either alone or in conjunction with the
4. Downy (wool) hairs, the entire covering of the sheep.

There are breeds of sheep which possess both kinds of hair (bristly and woolly hair), some which have only bristly hairs, and there are others with downy or woolly hair only (*Merinos*). The three first-mentioned hairs, no matter whether they occur alone or mixed with downy hairs, are always found distributed at fairly regular distances on the skin, while the downy or wool-hair always is seen arranged in tufts on the skin. The downy or woolly hairs are chiefly distinguished from the others in that, under the microscope, they are found always, or almost always, to contain marrow or pith. The bristly hair sometimes contains pith or medulla, sometimes not ; in sheep where it forms exclusively the hair-coat, it is for the most part devoid of medula. Like nails, claws, quills, etc., the hair has no blood-vessels or nerves, and can therefore be painlessly cut off ; while the root, with its deepest portion the bulb, constitutes the living portion of the hair. This capillary bulb is inserted in the hair-follicle, which contains the germ, which the bulb covers over like a hat. From this papilla the hair receives its nourishment.

According to its age and sex, the sheep has various designations ; the new-born sheep is called a lamb, and according to sex they are known as ewe lamb (she lamb or gammer lamb) and buck lamb (ram lamb or male lamb). After the completion of the first year, until breeding time, they are known as tegs, geldings, or yearlings. At the change of teeth, which is noted in the description of the skeleton, the designations according to the teeth begin. Two-toothed, four-toothed, six-toothed, eight-toothed.

After the first pairing time the male animal is called a ram, buck, steer ; the females are known as ewe lambs. Castrated male sheep are called wethers. The ram generally pairs at two years old, the female earlier. This act is called tupping or coupling. Only the ram is particularly eager at the rutting season, the ewe is less so. One ram suffices for 50 to 60 sheep. Gestation (pregnancy) lasts about five months, the normal time being 154 days—extremes vary from 145 to 158 days ; the number of young being one or two, seldom more. Prolific sheep can produce twice a year. The rutting of wild sheep does not seem to be confined to any particular season. Miscarriages are frequent with sheep. The tenderness of the mother for her young is not very pronounced. Shortly after birth the latter are able to follow the mothers.

The early history of the sheep is very deficient and full of gaps. The natural historians are not agreed as to whether the sheep forms a species of its own, or must be reckoned in the same category with the goat. Certainly several breeds of wild sheep bear more resemblance to the goat than to our domestic sheep. Moreover, sheep and goats who pair have young, but their offspring are barren.

There are now three great classes of wild sheep, with the following species belonging to them :—

I.—Wild sheep without external lachrymal pits : the "Machnen schaf," the "Nahur," and the "Takin."

II.—Species of Moufflon wild sheep : Sardinian-Corsican Moufflon, Persian Moufflon, Cyprus Moufflon, the "Sha" or "Shagu," and the "Urial."

III.—The Arcali breed of sheep : Argali, Karelin sheep, Archangel

or steppe sheep, palmyrene or Katchgar, broad-horned sheep, snow sheep, Hodgson sheep, and Brooko sheep.

As to the ancestors of the domestic sheep distributed throughout Europe, two kinds come specially under our notice, the Moufflon of the Corsican and Sardinian mountains, and the wild sheep of the Steppes, still seen now-a-days in fairly large numbers in Transcaucasia, and as far as Persia.

But the question of the origin of our domestic sheep is as little determined to-day as that of most of the other domestic animals, because authentic information is wanting as to how the transformation of the smooth surface-hair of the wild sheep into curly woolly-hair has been effected.

The divisions of the breeds of our domestic sheep vary much. While, among the newer authors, Sanson divides them into two principal groups—short-headed and long-headed breeds—each of which embraces a large number of subdivisions or families, Nathusius, in his treatises on sheep-farming, distinguishes the sheep chiefly by the length or shape of their tails, and groups them principally thus : (1) the short-tailed sheep, (2) the long-tailed sheep, the fat-rumped sheep, the fat-tailed sheep, and the long-legged sheep. Kühn and Stieger classify the domestic sheep according to the differences of the fleece : (1) hairy sheep, with proportionately short hair or wool, occasionally with accompanying down ; (2) mixed or felt-like woolly sheep, with longer fleece and thick under hair; (3) smooth or sleek-wool sheep, with wool of greater similarity ; and (4) curly or merino-wool sheep, in which the outer coat appears closely pressed together, and stubby hair or lamb-points are to be seen on the lambs only.

Wilkens's classification of the domestic sheep leans towards this grouping, or rather connects them to one another. He distinguishes between (1) sheep with hairy coats (hairy sheep) ; (2) sheep with mixed wool (bristles and downy hair), which again are divided into short and long-tailed breeds ; (3) sheep with shining wool (bristly hair) ; (4) sheep with sleek wool, poor in fat, which subdivide also into short and long-tailed breeds ; (5) sheep with curly wool, rich in fat (merinos or migratory sheep).

The enumeration of the many separate subdivisions of these groups of the breeds would lead us too far, and I content myself, having regard to the limited space in this little work, with enumerating the most important breeds only ; following, while doing this, Böhm's and Nathusius's classification of short and long-tailed breeds. In the first class are reckoned the sheep with 13 and less tail-vertebræ ; in the latter group, those whose tails contain more than 13 vertebræ. It is characteristic of short-tailed sheep that the tail is not covered with woolly hair, but with short erect hair, while that of long-tailed sheep (with one single exception, the long-legged sheep) is covered with wool. As subdivisions of the long-tailed (woolly-tail) sheep, one distinguishes again between fat-tailed sheep and narrow-tailed sheep. The fat-tails, by reason of the peculiar and often considerable deposit of fat, sometimes attain a weight of from 3 to 5 kilogrammes.

To the short-tailed sheep belong—(*a*) the horned, short-tailed mountain and heath sheep of Northern Europe, small of body ; the Scandinavian, Icelandic, and Faröe Isles sheep ; the sheep of the Orkneys and Shetlands ; the sheep of the Hebrides ; the Danish heath sheep ; and the heath sheep of the Lüneburg heath. Also the fat-rumped sheep of Central Asia and China, the Kirghise bell-sheep, and the burate and Calmuck fat-rumped sheep must be here included. (*b*) The hornless short-tailed sheep are—on the contrary to the above-named, which are for the most part described as mountain or heathland sheep—either sheep of marshy land, or animals who inhabit the great plains of tropical Northern Africa, and which are distinguished by shorter fleeces (without proper wool) and a hairy tail, round which great masses of fat are deposited (stump-tailed sheep). Among the marshy-land sheep calling for special notice is the North German (Friesland, Detmar, etc.) sheep, with mixed wool, which, on account of its plentiful milk-giving properties, is kept for milk production ; then there is the Dutch marshy-land sheep, the Faggas or Vaggas sheep,

a descendant of the Dutch sheep, which, in the lowlands of the Vistula and Nogat, are kept not in herds, but in small groups, and are celebrated for the flavour of their meat.

(2) The breed of the long-tailed sheep is divided into—(*a*) Fat-tailed sheep, and (*b*) Narrow-tailed sheep ; the first are again subdivided into fairly long-tailed and very long-tailed.

For European sheep-farming this group has no importance. Narrow-tailed sheep are also divided into two sub-groups : those sheep whose bodies are covered with hair, and those whose fleece consists of wool. The former are only bred in countries outside of Europe ; the latter, according to Böhm, are separated into three classes : (*a*) Sheep with mixed wool, composed of bristly hairs and downy (woolly) hairs ; (*b*) sheep clothed only with bristly hairs ; (*c*) sheep with only marrowless curly wool, or downy hair. In the first class (*a*) is placed principally the Cretan or Greek sheep, scattered over the S.E. of Europe ; the long, drooping-eared Italian sheep, and the mountain and farm sheep of Europe ; as also the Hungarian mountain sheep ; the mountain sheep of Transylvania ; the Sardinian, Swiss, French, and English mountain sheep ; as well as the country sheep of the Bavarian, Swabian, Bohemian, and Moravian moor districts, which are a cross between mountain and marshy-ground sheep, and which are at the same time much cross-bred with Merinos and Southdowns. With these must also be reckoned, because closely related, the farm sheep of Pomerania and Poland, as well as the English and French farm sheep. The second class (*b*), the long-tailed sheep, with fleece composed entirely of bristly hair, comes from the Arabian-Bedouin sheep, the Circassian sheep, and the hornless Leicester sheep, found throughout England. This last breed is noted for early maturity and quickness in putting on fat and flesh. The third class (*c*) comprises two subdivisions—(*A*) Sheep with sleek, gently-waved wool, and (*B*) sheep with curly wool. In the first are comprehended the smooth-fleeced German sheep (the Thuringian and Rhone sheep) ; the Rhenish, Hessian, and Lippe sheep, also called "Leineschaf" ; also that most highly esteemed breed of meat-furnishing sheep, the Southdowns ; the Shropshire-Ryeland or Herefordshire sheep ; also the frugal Scotch Cheviot sheep ; the Hampshire-down sheep (a cross of Southdowns with Berkshires) ; the Oxfordshire-downs (a cross of Cotswolds and Hampshires). In the second division (sheep with curly wool), there are only Merinos (nomadic sheep). Their origin can be traced back to the eighth and seventh century, when they are said to have developed in the basin of the Meander, in Asia Minor. Thence the woolly race of sheep gradually moved westward, through Greece and Italy to Spain. The Romans transplanted the Taranto sheep first to Cadiz and Cordova, in Spain, whence this breed spread itself over the whole Pyrenean peninsula, and later over the whole of Europe. The chief difference between these Merinos and the other transplanted breeds lies in the curliness of the wool. The hair, and the joining of it into strands, shows delicate regular waves, such as occur in no other race of sheep.

From the Merino sheep have resulted a large number of crossings with the sheep of the country. While the original Merinos of Spain, imported into other European countries, were only of medium size, those merinos bred in Germany, Austria, Russia, etc., show larger bodily proportions. They were also transplanted into South Africa and Australia, where they increased very quickly in number, so that the Australian sheep and wool production gradually influenced in an unlooked-for manner the European, as well as the American, market, and still continues to exercise that influence. In England the breeding of Merinos did not reach any considerable importance in any case, because the generally damp climate prevailing there exercises an injurious influence on the development of wool stapling, and the breeding of sheep for food seems more profitable. The different kinds or species of merinos at present bear the names of :—Electoral, Negretti sheep, and Combed or Carded-wool Merinos, each kind of these having again several subdivisions.

After this general glance at the race divisions of sheep, it will be well to say a few words here about the recognising of the various

breeds, and their principal uses. With this view they are distinguished as :—(*A.*) Wool sheep. (*B.*) Meat sheep.

(*A.*) According to the actual kinds of wool met with they are known as :—

(*a.*) The finer delicate carding-wool.

(*b.*) The stronger carding-wool.

(*c.*) The common carding-wool.

(*d.*) The finer carding-wool.

(*e.*) The common carding-wool.

And the names of the following sheep breeds may be said to be the producers of the above-named kinds of wool, in same order :—

For (*a*), the Electoral breed.

,, (*b*), the Negretti breed.

,, (*c*), the short-fleeced Country breeds.

,, (*d*), the Merino carding-wool breed.

,, (*e*), the long-fleeced Country breeds.

This classification cannot invariably be absolutely adhered to, because, on account of difference in breeding and crosses, and of the changes induced, doubts must necessarily arise as to which family the solitary herds are related. So numerous indeed have the isolated breeds and difference of their appellations become, that it will be sufficient for the compass of this little work, with regard to the wool sheep, to continue the above classified principal types.

(*a*). The Electoral breed shows delicate length of body, and is narrower in breast, neck, and hinder part of build than the Negretti ; the legs thinner and longer, the body less cask-shaped than in the latter. The skin is thin, and stretched rather tightly. The legs, the face, and the ears are often quite without wool, and the belly only lightly covered with it. The wool is fine, soft, delicate, thin, covered with clear, easily detachable fatty perspiration, and fairly dry. The hair is evenly waved in moderately high curves only. The wool on the extremities falls down but slightly. The fleece is more or less compact and closely knit together, and only has partings in the longer wool and thinner places. The upper surface of the staple has a finely granulated appearance.

(*b.*) The Negretti breed shows broader, fuller build of body, the back seems flatter, the body is more cask-shaped, the legs are shorter and stronger, the skin is tougher, more capacious, so that sideways on the neck, head, and breast, a strong, woolly dewlap is visible ; and on the bullocks, the flanks, as well as on the side of posterior portion of trunk and navel, may be observed very prominent protuberances. Belly and extremities are often thickly covered with wool. The wool has higher waves, is not so fine, delicate, or soft in hair ; but, on the other hand, it is stronger and regular, with golden-brown fatty perspiration thickly covering it. The wool on the extremities is coarser and smoother. The staple (or pile) is stumpy, the upper surface of the fleece therefore smooth. The lambs are born with wrinkled skin, covered with hair, and are thus inferior to the smooth, finely-grained Electoral lambs.

(*c.*) The short-wool Country sheep are characterised by the very flat waves or smoothness of their wool, in its considerable length. Thus it is really more carded wool than cloth wool, but is, however, much employed in the production of ordinary cloths. Its body is of middle size and width, the skin thin and sitting closely to the body, and without wool on head and legs. The hair is very much thicker than with the Merinos, also harder and more brittle, and is only permeated with fatty perspiration when the sheep are fed for fattening. There is proper stapling, but the hair is connected in little bunches and locks, so that the fleece appears open. The different breeds of Country sheep do not vary much in essentials. The North-German (Pomeranian, Russian), as well as the middle German (Saxon), also those types bred in the Rhine and Danube districts, in the Fichtel mountains, in the mountains of the Rhone and Weser, in French Switzerland, in Franconia and Hesse, are kept mostly by peasants or in small flocks, and are very well fitted (especially the South-German breeds, which exhibit a somewhat stouter build of body) for crossing with the English meat sheep, while

up to the present time far too little care has been bestowed on the improvement of the wool.

(*d.*) The Merino carded-wool sheep resembles the Electoral in build, but under the same good treatment these animals become correspondingly larger and broader, the skin is less thin and tight, yet not wrinkled, and fairly well covered. On account of the length of the wool, a close staple can only be acquired where the wool is not too long, and combined with care and good feeding, so that a regular arrangement of locks rather than a real staple is to be seen.

The wool on the fore-part of the body is generally longer, and that on the back part generally loose in the staple. Sebaceous secretion is seen but seldom. The wool shows a certain silvery lustre, great softness and flexibility, the hair itself having but little elasticity. The principal types of these breeds are the German and French carded-wool sheep.

(*e.*) The long-wool Country breeds are divided into two classes, those of smaller stature and those with larger build of body. To the first class belong the common German country sheep, in so far as these do not come under the head of short-fleeces. They have the same build and covering as the short-wool Country races, and thus come under the type described in (*c*). The Hanover sheep form an exception, especially the heath sheep spread over the Lüneburg heath, the smallest of all sheep (20 to 30 kilog. living weight). Both sexes of these are horned, and have a very long, coarse, smooth wool, hanging in strands and tangles, and mixed at the roots with fine down. They form a perfectly independent breed. The colour of the wool is chiefly white, grey, light and darker grey.

Among the more important long-haired Country races is reckoned the Marshland or Lowland sheep, and several English species; also the long-legged lowland races of Denmark, Friesland, the "eider town" (Eiderstädische), and Dutch sheep, which last is also extensively scattered in the north-west of Germany, but has only local importance in wool production. Also, the already mentioned Faggas of the Vistula district, narrow long-legged animals with savoury flesh, belong to this class.

(*B.*) Meat sheep. While in earlier times little importance was attached to the production of good mutton in general, and especially in Germany, so that mutton was only eaten by the lower ranks and the poorer towns, the importance of mutton-breeding has increased in a marked manner with the rise of sheep-rearing in general, and particularly with the introduction of Merinos. In Germany, certainly, there are but few breeds preferred and demanded as better meat. These are the Frankish sheep, the flocks of the Fichtel mountains, the Hesse and Weser sheep; as well as several Country breeds of larger build of body, which yield good results for fattening and killing. The extensively scattered Merinos can mostly only be utilised for their flesh at the sacrifice of wool-producing, and specially of the obtaining of better and finer kinds of wool. In regard to the breeding of mutton, England stands in by far the first rank; and, in later times, Australia and South Africa also. Of the meat races reared in England, two among many are particularly noted—the Leicester breed and Southdown sheep. The first-named exhibits a long, broadly-built body, well adapted for fattening, rather small head, straight back, deep, broad chest, wide pelvis, and cask-shaped body; the latter are similarly shaped, but smaller, and therefore rounder. Other well-known breeds are the Shropshire and Oxfordshire sheep, which have been much introduced into Germany and other continental countries. English breeds which are most celebrated are the varieties of short-wool sheep, which are known as "downs," such as South-downs, Shropshire-downs, Hampshire-downs, Oxford-downs; and among the long-wool—Lincolns, Leicester, Border Leicesters, and Cotswolds. Horned sheep are not common in England, but the Somerset and Dorset-horns are among the most esteemed breeds.

## DENTITION OF THE SHEEP.

The terms which are applied to the teeth of the ox for the purpose of description may be used in regard to the teeth of the sheep. Eight incisors, central, middle, lateral, and corner teeth, are found in front of the lower jaw only, the corresponding part of the upper jaw being provided with an elastic pad, as in the ox. Molar teeth are designated by numbers, to indicate their position, and for the purpose of judging the age. These teeth in the sheep may be described as corresponding to the teeth of the ox in all general points, except in regard to their size.

*At birth*, the arrangement of the incisor teeth of the lamb is peculiar, as shown in Fig. 1.

Fig. 1.—Incisors of Lamb at Birth.

Generally the whole temporary set of teeth may be recognised, but only in outline, as they are nearly covered with the gum. The central incisors are most advanced, and next in order come the laterals, leaving the middle and corner teeth considerably below them. Very often the cutting edges of the front and third pairs of teeth are through the gum. All these peculiarities are seen in the illustration, which may be accepted as a representation of the ordinary appearance of the teeth of the lamb at birth.

By the end of the *fourth week* all the temporary teeth, eight incisors, and three molars on each side of the upper and lower jaws, are well up.

From the time of the perfect eruption of the temporary teeth, at the age of one month, to the cutting of the first pair of broad teeth, central permanent incisors, at the age of one year to fifteen months, the only changes which will guide the expert to a correct opinion of the age are those which affect the molar teeth.

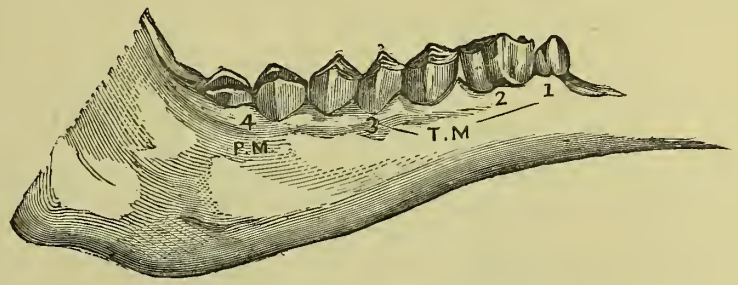


Fig. 2.—Molars of Lamb at Three Months.
P.M., permanent molar. T.M., temporary molars.

At *three months* the first permanent molar, the fourth in situation, is cut, and is recognised by its recent appearance in comparison with the tooth immediately in front of it, the third temporary molar, which shows signs of wear.

In the above illustration (Fig. 2) the appearance of the molars at the age of three months is shown.

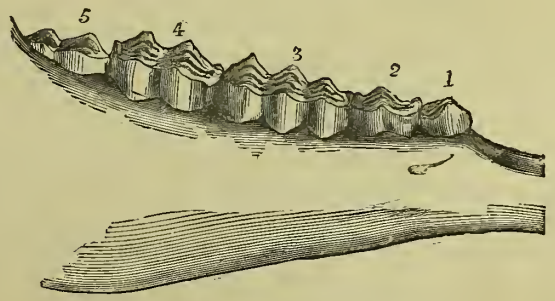


Fig. 3.—Molars of Sheep at Nine Months.

During a period of five or six months from the cutting of the fourth molar, there is nothing to guide the examiner except the growth of the teeth and of the jaw, which results in leaving a space behind the fourth molar. At the age of *nine months* this space is occupied by the fifth molar, as shown in the drawing, Fig. 3.

Fig. 4.—Incisors (temporary) of Sheep at One Year.

At *one year old* the teeth will present the following appearances: Incisors are worn on their upper surfaces, especially the central and middle, and to some extent the lateral teeth; the corners are not worn. In sheep which are feeding on turnips, some of the incisors, and in certain cases all of them, are broken off, and in very forward animals the central permanent incisors are cut; but they are never perfectly level and regular at this age.

Fig. 4 shows the average state of the temporary incisors in a well-preserved mouth at the age of one year. At the back of the mouth the recently cut fifth permanent molar (Fig. 3) is seen, while the teeth in front of it are all worn on the surfaces; these appearances, taken in connection with the state of the incisors, will satisfy the examiner that the sheep is about the age of one year.

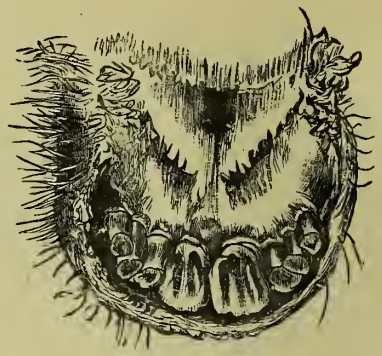

Fig. 5.—Incisors of Sheep, Central Permanent Incisors well up, at Fifteen Months.

The first broad teeth, central incisors, are usually cut soon after one year old, and are well up at *fifteen months*, as shown in the illustration (Fig. 5).

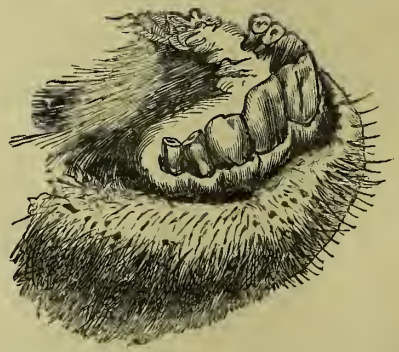

Fig. 6.—Incisors of Sheep, second pair of Permanent Incisors cut (Four Broad Teeth), at One Year and Ten Months.

At *eighteen months* the sixth permanent molar is cut, and the recent appearance which this tooth presents is better evidence of this

age than can be obtained by an inspection of the incisors. Occasionally, in very forward mouths, the second pair of broad teeth will be cut; in other cases, there will be no signs of their appearance until the sheep is approaching the age of two years (*see* Fig. 6, which shows the second pair of broad teeth at the age of one year and ten months). So far, therefore, as these teeth are concerned, the examiner may be left in doubt as to whether the sheep is one year and six months or two years old; and it is absolutely necessary that he should inspect the molars, in which important changes occur between the ages of fifteen months and two years.

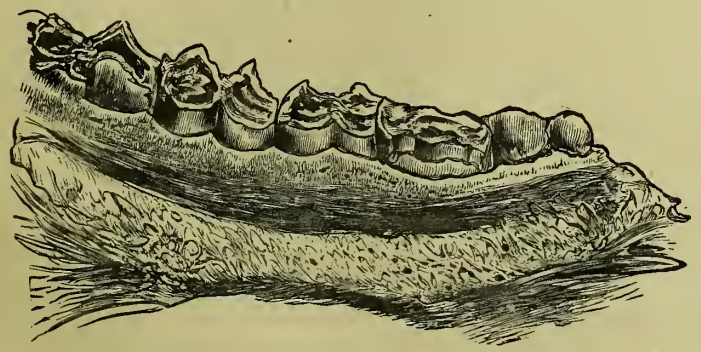

Fig. 7.—Molars of Sheep at One Year and Ten Months.

Soon after the sheep reaches *one year and a half*, the sixth molar begins to protrude through the gum. Shortly afterwards the two anterior temporary molars give place to the permanent teeth, and the third temporary molar is a mere shell covering the top of the permanent tooth, which is coming up beneath it, and pushing it out of its place, as shown in the last illustration (Fig. 7).

In this drawing the average condition of the molars of the sheep just under *two years* is exhibited. The two anterior permanent molars are cut, the third permanent molar is coming up under the temporary tooth, which in many cases will have fallen out, leaving the permanent organ to be seen below the level of the other teeth. At the back of the jaw the sixth molar is seen, but does not show any marks of wear, and this tooth, it may be observed, affords the most valuable evidence at a critical period. In the class "not exceeding two years," many of the sheep are stated to be twenty months old, and some of the animals may have the third pair of broad teeth not fully developed, but fairly advanced. When sheep exhibited as under two years of age are found to have six broad teeth, the animals are naturally objects of suspicion, and further evidence is sought for in the molars, which, as the drawing (Fig. 7) shows, exhibit very characteristic marks at this period. Generally it may be taken as a fact that if a sheep with six broad teeth shows the three anterior molars in a state which proves that they are recently cut, and especially if one or more of the temporary teeth still remain, the age does not exceed two years.

Six broad teeth well up may generally be taken to indicate that the sheep is *two years and three months* (Fig. 8), but in many animals they are not present until two years and a half. On the other hand, they are not uncommonly cut at twenty-two months old, a fact which

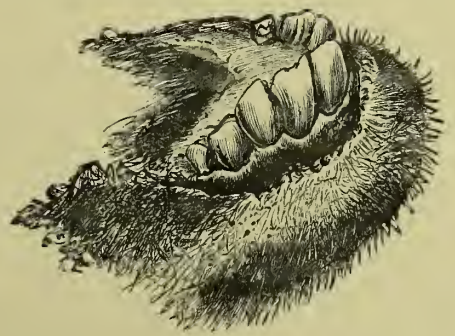

Fig. 8.—Six Broad Teeth at Two Years and Three Months.

was recorded by the writer more than thirty years ago, and since then they have been met with at twenty months.

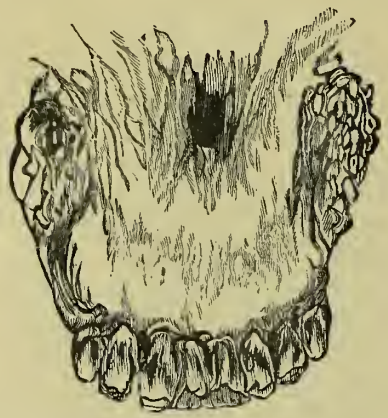

Fig. 9.—Incisors of Sheep at Three Years Old, showing recently cut Corner Teeth.

Dentition in sheep is completed by the eruption of the corner permanent incisors, which are usually cut at the age of three years, as shown in the above drawing.

In some cases the corner teeth are not well up till the animal is nearly four years old, so that there is a possibility of a mistake being made as to the age to the extent of a year, by an examiner who contents himself with an inspection of the corner incisors. No difficulty, however, would be experienced in deciding whether the corner incisors represent three years or four years, if the state of the other incisors is taken into account. At four years of age the six broad teeth will show marks of wear; the central incisors especially will be worn hollow on their upper surfaces, the middles and laterals also showing well-marked tables in the place of sharp-cutting edges; while the recently cut corner incisors, supposing their eruption to have been delayed till the sheep was nearly four years old, will present a marked contrast to the rest of the teeth which have suffered from attrition. These appearances are shown in the next drawing (Fig. 10) of the mouth of a sheep at the age of four years.

Fig. 10.—Incisors of Sheep at Four Years.

After the age of four years, and indeed from the time of the completion of permanent dentition, whether early or late, the changes which are effected in the form of the incisors by wear vary according to the nature of the food, and the examiner must be content to limit his inquiries to the period within which is comprised the eruption of the permanent teeth.

## CONFORMATION.

It was stated in the companion work on the Ox that the form of the animals intended for food had undergone considerable modifications under the influence of artificial selection. The sheep is not an exception to the rule. By careful selection the breeder has succeeded in producing sheep which, however they may vary in size, the perfection of form is deemed to be that which will admit of the deposit of fat and flesh of the best quality, to the exclusion of offal and the less favourite parts.

Certain divisions of the carcase, by means of imaginary lines, are recognised in the sheep as in the ox; but in the sheep the divisions are fewer, as would be expected from the smaller size of the animal.

The chief parts are the head, neck (including scrag and best end), the breast, shoulder, loin, and leg. The leg and loin together form the haunch; and two loins remaining attached, *i.e.*, without being divided through the centre of the backbone, are known as the saddle. In the ox the same part is distinguished as the baron, and is only cooked to be served at large banquets.

## THE SKIN, ITS APPENDAGES AND FUNCTIONS.

The skin of the sheep, like that of other animals, consists of two layers—the external (*cuticle* or *epidermis*), and the inner or true-skin. This latter is furnished with blood-vessels and nerves. From the vessels of the true-skin, the outer skin, or cuticle, is secreted. This is divided again into two layers, the inner one, or "Malpighian mucous layer," and the outer dense membrane, consisting of flattened cells. The formation and growth of the hair takes place in the hair-follicles, in a similar way to that of the cuticle, from the cells of the vascular membrane of the true-skin. Distributed through the true-skin are the sebaceous glands, which secrete the fluid known as wool-fat, which varies in consistency. With this wool-fat is also mixed the gaseous or fluid perspiration, coming from the deeper-seated and funnel-shaped perspiration glands discharging into the outer skin. In the so-called yolk, or sebaceous fluid, the two secretions are present in conjunction. The skin of the sheep is thin, and in some breeds—Merinos, for example—is wrinkled. The cutaneous and sebaceous glands are the more numerous in proportion to the thickness of the fleece. (The thicker the fleece, the more numerous the glands). A particular kind of sebaceous gland, peculiar to the sheep, is the indentation of the outer skin between the claws, known as the interdigital canal.

The function of the skin is not only to transmit feeling and secrete fluids, but also to protect the organs of the body against outside influences, and to assist in binding the structures beneath it.

## MUSCLES.

On removing the skin, the cutaneous muscles and layers of fat are visible. Almost all the best breeds of sheep fatten very easily, and thus the padding of fat beneath the skin and cutaneous muscles often attains an unusual thickness. Under this bed of fat lies the various muscles of the body, and by their contraction the different movements of the limbs and other parts are effected. In the voluntary muscles, the fibres are marked by transverse lines (striæ); these muscles are commonly called flesh. In the involuntary muscles of the intestines (gastric intestinal canal, organs of sense, blood and lymphatic channels) this oblique marking of the muscular fibres is lacking, but they exist in the muscle fibres of the heart. The muscles are either attached directly to the bones of the skeleton, or are continued by fibrous cords or tendons, by which they are connected with the bones. Under the influence of the will, which is controlled by nerves attached to the separate muscular filaments, muscles are made to contract, and thus accomplish all the acts of locomotion. The naming of the separate muscles is arranged partly according to their functions, and partly according to their attachment to the bones which they connect.

Between the skin and muscular system, and also between the separate muscles, there is in fat animals a large amount of fat deposited. This fatty tissue is composed of sharply defined cells of a circular or oval form, united in masses or clusters. The quantity of fat is regulated by the nature of the body, and aids, on the one hand, in filling up hollows, and on the other hand, it represents a substantial reserve of food, so that fat animals are able, by reason of their wealth of fat, to offer a longer resistance to starvation than thin animals. Besides this,

the layer of fat surrounding the body being a bad conductor, checks the too great radiation of the body's heat.

Table IV. shows some of the muscles which become visible when the cutaneous muscular system and layers of fat are removed. The deeper seated muscles cannot of course be seen.

## THE BONES OF THE SKELETON.

The skeleton forms the framework of the body, and is composed of its collective bones. Partly they enclose and protect the vital internal organs, such as the brain, the spinal marrow, the organs of the chest, abdominal and pelvic cavities; and, in part, they assume the form of supporting columns united by joints, which are moved by the muscles. In almost all bones may be distinguished a hard compact bony material, surrounding the spongy or cancellated structure. This last forms numerous mesh-like compartments or cells (medullary cells), which contain the marrow of the bones.

Cylindrical bones have in the centre a particularly strong, compact, bony substance, and, instead of the cancellated structure, there is a complete marrow cavity. Bones are classified according to their shape, their position in regard to the body, and their physiological importance. With regard to shape, they are distinguished as long or cylindrical bones, broad or flat bones, and short bones. In respect to position, they are divided into bones of the head, trunk, and extremities. The natural colour of the bones is a yellowish pink, caused by the mixture of fat, blood, and juices; when bleached or calcined they are almost snow-white. Their component parts are basal phosphoric acid, calcareous earth, carbonic acid lime, a little fluoride of calcium and phosphoric acid magnesia (mineral constituents), and gelatine (organic constituent). The bones collectively are covered with a periosteum, a dense fibrous membrane through which the vessels and nerves enter the bony structure and supply the necessary nutriment. Bones are united to each other in various ways, forming joints which are either movable or immovable. The formation of the joints is arranged in such a manner that the rounded ends of bones are firmly fixed into the sockets of the neighbouring bone by the aid of capsular and other ligaments. According to their power of movement, joints are classified as fixed joints, rotary joints, gliding joints, and hinge joints. The immovable joints are formed by sutures (true suture, squamous suture), or by so-called false sutures, and by wedging, as in teeth. The ends of the bones forming true joints are covered with a bluish-white, elastic, pliable, exceedingly smooth cartilage, the use of which is to prevent friction between the bones, and to lessen the concussion in walking, running, leaping, &c.

As mentioned above, the bony structure is divided, according to position, into bones of the head, trunk, and limbs. The head-bones are again subdivided into skull and facial bones. While the first-named surround the cavity of the skull or brain cavity, the latter lay the foundation for the cavities of the nose, mouth, and throat. In the skull-bones are included the frontal bones, the parietal bones, the occipital bones, the temporal bones—the fibrous portions of which contain the organs of hearing—and lastly, the ethmoid or cribriform bone, which forms the division between the cavity of the skull and the other cavities below it. The bones of the skull collectively, as well as the face bones, with the exception of the lower-jaw and hyoid bone, as well as the vomer, are fastened together by sutures. The bones of the face are divided into Upper-jaw bones (containing the upper grinders), the anterior Maxillary bones, the Nasal bones, the Zygomatic bones, Lachrymal bones, Palatal bones, the Pterygoid bones, and the Vomer. In the bones of the head are reckoned also the lower jaw bone, a bone formed of two halves (branches), united in the middle by cartilage, and having on its broad lower edge eight grooves for the reception of the 8 incisors. The two branches have each an anterior edge of dental cavities, in which are found six sockets, in which are fixed the 12 back molar teeth or grinders. Between the branches of the lower jaw lies the bone of the tongue, the hyoid bone, serving as

a support to the larynx and pharynx, and which is fastened to the skull by means of a so-called seam or suture, and is the point of attachment for many of the muscles. As already mentioned, the sheep has in the lower jaw 8 incisors (these are wanting in the upper jaw, and are replaced, as in the ox, by a cartilaginous protuberance), and 24 grinders or molars, half in the upper jaw and half in the lower.

## THE BONES OF THE TRUNK

are divided into bones of the vertebral column, bones of the chest, and bones of the pelvis. The bones of the first-named are again divided into cervical, dorsal, lumbar, sacral, and coccygeal vertebræ. Each true vertebra consists of the body, the arch, and the processes; the body is the under and thicker part of the vertebra; the arch bending over it forms, with the body, the spinal marrow and hollow, and these contiguous cavities collectively represent, in the closely connected vertebræ, the spinal-marrow canal. In this latter lies the spinal marrow with its membranes. The intervertebrate openings lying sideways, and in pairs, permit the entrance and exit through them of the vessels and nerves. On the upper side, the "spinal processes" spring from the arch; on the front and back of the arch are found the oblique processes; and lastly, at the sides of the arch, the transverse processes appear, which show on the dorsal vertebræ the articular facets for the ribs, forming the walls of the chest.

The sheep has 7 cervical vertebræ, 13 dorsal vertebræ, 6 to 7 lumbar vertebræ, 4 to 5 sacral vertebræ, and 3 to 24 coccygeal vertebræ; the tailless sheep have only 3 coccygeal vertebræ, the short-tailed 12 to 16, the long-tailed 22 to 24. The two first cervical vertebræ are known as Atlas and Axis. The shape of the cervical vertebræ, as well as the dorsal, are exactly similar to those of the ox, though, of course, proportionately smaller. The spinal processes are most strongly developed in the dorsal vertebræ, the third having the longest, and the fifth and sixth the broadest spinal process. As a rule, there are 6 lumbar vertebræ, but often 7, counting a normal number for dorsal vertebræ.

The sacrum consists originally of 4 or 5 vertebræ, which in an adult sheep are united to form one bone; it is situated between the bones of the pelvis, and forms the end of the spinal canal. There is not the slightest trace in the coccygeal vertebræ of any continuation of the spinal canal.

The cavity of the chest is formed by the dorsal vertebræ already described, the ribs and the sternum. There are 13 pairs of ribs, 8 so-called true ribs and 5 false ribs on each side; the front portion of the ribs has, in the lower middle line of the body, a central bone—the sternum—between them, which unites the corresponding ribs on either side into complete arches (visceral arches). Those ribs joined by the sternum are known as the true, while those which do not reach it directly are called false ribs. The junction of the ribs with the sternum is effected by means of the costal cartilages lying between them. The visceral arches serve to protect the vital organs lying partly in the pectoral cavity and partly in the abdominal cavity, and form a bony support for them. The sternum is composed of seven parts, and has on its sides eight grooves for the reception of the cartilages of the true ribs. The pelvis is formed of two divisions, each of which is composed of three separate bones, united together firmly in early youth. These are the *ilium ischium*, or hip-bone, and *os pubis*. These three bones unite for the formation of the hollowed cavity—*acetabulum*—to receive the heads of the thigh-bone.

## BONES OF THE LIMBS.

The limbs are divided into two front and two hinder limbs. The front limbs are composed of the shoulder-blade, the fore-arm bone with the elbow bone, and of the bones of the carpus and foot. The shoulder-blade is a long triangular bone, which has on its upper side a supplementary cartilage. The junction of the shoulder-blade to the trunk is effected by a muscular structure. The outer surface is divided into

two halves by a ridge. The shoulder-blade narrows towards its lowest part and exhibits a distinct neck, which again broadens out and grows thicker, and bears the joint-cavity for the head of the second bone—the shoulder-bone *(humerus)*. In conjunction with this bone it forms the shoulder-joint. Then come the radius and ulna. The carpus bones form the so-called knee. They lie in two rows, the upper of which consists of four bones—the unciform bone, the polygonal bone, the cuneiform bone, and the cuboid bone; the latter of which is formed of two bones—the semi-lunar and the conical bones. The carpus is connected by joints on its lower side with the shank-bone, which is not connected with joints with the rudimentary collar-bones. The two toes consist of three parts—the pastern, coronet, and foot-bones, which latter are enclosed in a horny covering, the frog being absent. The flat of the sole of the claws is triangular and pointed in front. The bones of the hind limbs consist of the thigh-bone connected to the pelvis, the tibia with the patella, the tarsus (hock), the metatarsus (shank-bone), and then the foot bones. The thigh-bone is the support of the thigh, and forms below, with the patella and tibia, the stifle joint. The tibia is connected at its lower point with the tarsus or hock. This latter is composed of five bones lying above one another; towards the outside in two rows, and at the inner side in three rows. They are known as the hock or heel bones (*calcis*), the astralagus, the scapho-cuboid bone, the first cuneiform bone, and the (intergrown) second and third cuneiform bones. From the shank-bone, to which the collar-bone is only fastened as a small round little bone, the arrangement of the foot is the same as on the fore limbs. Besides these there are, on fore and hind limbs alike, on the pastern and claw-bones of each toe, three small bones, attached by ligaments, the so-called sesamoid bones, which provide the slippery surface for the sinews.

## INTERNAL ORGANS.

Circulatory System.—The blood flows through the whole body in the channels marked out for it by the blood-vessels. The system consists of a central organ—the heart, and of an arrangement of tubes, closed on all sides—the blood-vessels. The centre organ works like a force and suction pump, and its function is to drive the blood over the whole body. The tubular system of the blood-vessels, which begins at the heart, and eventually ends there, may be classed in three great divisions: (*a*) Blood-vessels in which the blood flows *from* the ventricle of the heart into the different parts of the body = arteries; (*b*) vessels in which the blood moves back *towards* the auricles of the heart from the various parts of the body = veins; (*c*) vessels of the smallest diameter, which cause the blood to pass from the most delicate arteries to the beginnings of the veins = capillaries.

## THE HEART

Is a large hollow muscle, situated in the pectoral cavity, and composed of involuntary muscles, which represent the driving apparatus of the entire circulation. It lies between the two lungs, and is entirely covered by them. Between the lungs and the heart there is the membranous sac (pericardium) surrounding the heart; it is held in position by the large blood-vessels which go to the spinal column and into the lung. The heart lies obliquely from front to back, and slightly inclined to the left. The heart reaches altogether from the third to the sixth rib, and the side-surface is nearer the left pectoral wall than the right. The pericardium enclosing the heart is a cone-shaped bag, which, considered apart from the mediastine covering it, consists of two layers—a fibrous and a serous coat. The inner surface of the pericardium exudes a slight moisture, which serves to keep the outer walls of the heart, as well as the pericardium itself, moist and slippery. The heart itself is shaped like a cone, the broader part (basis) upwards, and the point lying downwards and slightly towards the left. On the first-named are all the large blood-vessels, the point lying free in the pericardium. The right and left side-surfaces are distinct, and on each is found a vascular furrow—the right and left longitudinal

furrow—defining the limits of the ventricles. Besides these there is, on the basis, an oblique furrow, dividing the auricles from the ventricles. The heart contains four cavities, two lying at the basis and known as auricles, while the two others are situated in the body of the heart and are known as ventricles. The auricles are two muscular bags, and are divided into right and left auricle, completely separated by a partition. The two ventricles lie below the auricles, and have much thicker muscular tissue, and are also completely separated by a muscular partition. The left half of the heart contains arterial blood, and the right half venous blood. The ventricles are directly connected with the auricle on the same side by an opening, which is closed by the neutral valves. Besides this, each ventricle has on its upper side yet another small arterial opening, capable of being closed by the semi-lunar valves, through which the blood in the large vessels—on the left the aorta, on the right the pulmonary artery—makes its exit. The two valvular arrangements between auricles and ventricles—in the left half of the heart the bicuspid, in the right side the tricuspidal valve—prevents the blood, which, at the expansion of the heart (Diastole), streams from the auricles into the ventricles, from returning to the auricle at the contraction of its ventricle (Systole). The same function is performed by the above-named arrangement of semi-lunar valves (three in number) at the point of exit of the two great blood-vessels (the aorta and pulmonary artery), which prevent the reflux of the blood from these vessels returning to the ventricles. The valves are retained in place by a number of tendinous filaments which come from the inner wall of the heart, and are attached to the edges of the valves.

The blood is composed of a transparent, colourless, or light yellow fluid, the blood plasma, and the particles held in suspension in it, the blood corpuscles. It is the true fluid nutriment of the animal body, and flows incessantly during the life of the animal through the body, carrying the material necessary for formation and growth, and for the various secretions. The blood corpuscles, or cells, are divided into the red corpuscles and the proportionately few white corpuscles. Under the microscope the former appears as small round discs with dark centres. Their colouring depends on the colouring matter in the blood, the so-called hæmoglobin. The colourless or white particles are the same as the lymph corpuscles, are nucleated, and are found in varying numbers in the blood.

There is a difference between arterial and venous blood. Arterial blood is bright red, richer in oxygen, and coagulates more quickly than venous blood. The brighter colour is due to the greater amount of oxygen, and its influence on the colouring matter on the blood: the quantity of carbonic acid is less. On the other hand, venous blood is dark red in colour, owing to the larger quantity of carbonic acid.

As already stated, the circulation is accomplished after the manner of a suction and force-pump. The forcing out, which sets the blood in motion, proceeds from the heart. By the contraction of the muscles of the heart, in the first instance, the blood for feeding the body is driven out from the left ventricle in rhythmical jerks into the great aorta. This is called throbbing. This wave of blood thus called into action continues through the whole arterial system, and can be felt in the most remote blood-vessels as a regularly recurring beat—the pulse. Shortly after leaving the heart, the great aorta divides in two greater branches—the anterior and posterior aortas, which again branch off in front and back parts of the body in ever smaller and more delicate branches and passages, until eventually they terminate in the capillary network. The blood collected in the small veins issuing from the capillary network, which gradually become larger vessels and conduct the fluid back to the right auricle through two large important veins—the anterior and posterior vena cava. From the right auricle the blood passes into the right ventricle, and is here, by its muscular contraction, driven through the pulmonary artery into the lungs. In the lung, the artery divides into branches large and small; these lead to the respiratory network of capillary vessels, which pass it on into the pulmonary veins. In this capillary system the exchange of gases in the blood takes place, it giving off carbonic acid into the air, and

taking up in its stead the quantity of oxygen necessary to life. The veins of the lungs, which, in spite of their name, convey arterial blood, unite in several branches, and discharge into the left auricle. From here the blood flows into the left ventricle, from whence it is expelled into the aorta.

Lymph Vessels.—The lymph vessels represent a capillary system which originates in the tissues of the body, and finally discharge their contents into the blood-vessels. The lymphatic vessels unite to form two principal branches—the lacteal duct and the thoracic duct, which discharges the lymph into the right and left axillary veins. All the lymphatic vessels, before they reach one of these chief branches, pass through one or more lymphatic glands, which are attached in large numbers mostly to fixed parts of the body. The fluid in the lymph vessels is not uniform in character; that in the lymph vessels of the digestive canal is called Chyle (milky fluid or juice), that in all other vessels is known as lymph. Both fluids mix in the lacteal duct.

## NERVOUS SYSTEM.

The nervous system governs and guides all sensation and motion, both that accomplished by the voluntary as well as the involuntary muscles. The central organ of the nervous system is the brain, which lies in the cavity of the skull. It is divided into the cerebrum and cerebellum, and the medulla oblongata. The cerebrum is divided into two halves (hemispheres), which display on their outer side a large number of so-called convolutions. The cerebellum lies behind the cerebrum. In section it displays a delicate tree-like drawing, called the *arbor vitæ* (tree of life). The medulla oblongata is continued in the spinal cord. Like the brain, this lies well protected in the spinal canal, already mentioned in describing the bones. Brain and spinal marrow are covered with two membranes. The brain is the seat of the mental functions, the automatic and reflective.

## ORGANS OF SPECIAL SENSE.

In connection with the nervous system, there are special organs of the senses—smell, sight, hearing, taste, and feeling. The sense of smell is located in the nose; of sight, in the eyes; of hearing, in the ears. With regard to the details of structure of the organs of special sense, they are almost identical with those of the ox, as described in the treatise on that animal.

## RESPIRATORY SYSTEM.

The organs of respiration are chiefly situated in the pectoral cavity. The respiratory apparatus embraces a series of tubes and cavities, including the lungs with their accompanying ducts, situated in the pectoral cavity, and with the windpipe and nasal cavities. In closest connection with the breathing apparatus are the organs of voice, the larynx, as well as those organs for the sense of smell found in the nose. The interchange of gases during respiration does not take place in the lungs only, but all over the body. The nasal cavities are two spacious cavities, separated by a middle division. They are covered with a very vascular mucous membrane, which is covered with mucous secretion, which prevents the entrance of solid dust particles into the air passages. The larynx, as well as the trachea and its branches, are also lined by mucous membrane. The trachea is a membranous cartilaginous canal, commencing at the larynx, and leading to the lung. It consists of from 48 to 55 loosely-connected rings of cartilage, and divides, after entering the pectoral cavity between the two first ribs, into three branches, which subdivide inside the lungs, like branches of a tree, into increasingly slender minor branches (bronchi), and finally end in the grape-like arrangement of air-cells. All our domestic animals possess two lungs, a right and a left, covered with thin, smooth membrane, the pleura. They completely fill the space in the cavity of the chest, except that allotted to the heart and other organs of the pectoral cavity. In ruminants the right lung

is divided into four to five lobes, and the left lung into two to three. The lung, empty of blood, is of a pale yellowish-red colour; that filled with blood is dark red. Healthy lungs, when taken out of the pectoral cavity, collapse, but float in water if the animal has once breathed.

The number of respirations of the sheep, as of all smaller domestic animals, varies very much, and, according to movement or excitement, the climatic temperature is between 30 and 120, or more, respirations in the minute.

## DIGESTIVE SYSTEM.

The organs of Digestion form a continuous tube of varying size, lined with mucous membrane, from which numerous glands discharge their secretion. It commences in the cavity of the mouth, and ends at the further extremity of the intestinal canal. The separate organs lie in the cavities of the mouth, chest, abdomen, and pelvis. They are divided into the organs of reception, digestion, swallowing,—the true digestive organs and the secretory organs; with these must also be reckoned the salivary glands, the hepatic and pancreatic gland, which must be regarded as complements, as they are directly connected with digestion. The conducting tube, as far as the insertion of the œsophagus into the stomach, is provided with voluntary muscles, and from there to the end of the rectum with involuntary ones. In the abdominal cavity the whole of the organs are covered with a serous membrane—the peritoneum.

After the food has been seized by the incisors or lips, it is pushed by the tongue between the molars, whose function is to grind it small. Here the salivary glands step in, and, in ruminants, the fermentation contained in the saliva, promoting digestion, is mixed with the food. After a corresponding grinding smaller, this last-named is sent on to the first stomach through the pharynx and a tube, consisting of two membranes—a mucous membrane and a (in ruminants) very firmly fixed muscular membrane—the œsophagus, which leads into the first stomach —*rumen*. The stomachs, consisting of four divisions, form a bag, composed, like the whole of the true digestive canal, of three structures—the mucous membrane, the muscular coat, and serous covering of the peritoneum. This bag fills the anterior and left posterior divisions of the abdominal cavity almost entirely. The function of the first three stomachs is really to store up and macerate the food, and may thus be regarded more as a larger bulging of the œsophagus. They are called the paunch, the reticulum, and the omasum. The fourth stomach, the maw or abomasum, is the real digesting stomach. In sucking ruminants this is the only one fully developed: the paunch enlarges when the lamb eats solid food, and the second and third stomachs proportionately later. The paunch, when fully grown, is the largest division of the stomach, divided by a furrow into a large bag on right side and a smaller one on the left. The opening of the œsophagus lies on the border between the front end of the left bag and the reticulum; the opening to the latter being below the opening of the œsophagus. The mucous membrane of the paunch has, like that of the second and third stomachs, no glandular organs, but, on the other hand, a number of small secretory tufts, varying in size. The inner surface of the second stomach is divided up by a number of ledges, crossing each other at obtuse angles, forming more or less regularly six-sides cells. On account of these meshes, this stomach is also called the honey-combed stomach, and meshed stomach; it is furnished with strong layers of muscles, which may assist the muscles of the paunch to push the œsophagus for second mastication—rumination. After the second chewing the food passes again into the rumen, and on to the second, third, and fourth. The fourth stomach is provided with numerous glandular organs, and in it real digestion begins.

The intestinal canal is formed by a continuous tube, varying in width, and which is nominally divided into two portions—the large and small intestines. The small intestine reaches from the stomach to the cæcum, and is again divided into the duodenum, the jejunum, and the ilium. The large intestine is divided into the cæcum, colon, and rectum. The whole length of the intestinal tube reaches in sheep about 28

metres, of which 21 belong to the small intestine and 7 to the large. The intestinal canal lies obliquely on the right side of the paunch, and is here covered by the doubled fold of the great tissue (peritoneum ?). On the lower and convex side lie the small intestines, which form a number of intestinal loops hanging on a short mesentery. At a short distance (36 centimetres) behind the exit of the fourth stomach (pylorus), the small intestine is pierced by the common gall-duct, and, somewhat further towards the back, by the outlet of the pancreatic gland, which carry off the secretions of the liver and pancreas.

Two large glands, the liver and the pancreas, stand in direct connection. The first lies in the anterior region of the abdomen, immediately behind the diaphragm, to which it is attached by ligaments, and is the largest gland in the animal body. When normally full of blood it appears to be of a very dark reddish-brown colour, very much lobed, and, in the living animal, of a somewhat pulpy consistency. The secretion of the liver is the gall, given off by the hepatic cells, first in tiny vessels, gradually in larger ones, and is brought to the biliary ducts through the gall-bladder duct to a collecting reservoir, the gall-bladder. Through the common biliary duct, the gall, as already stated, is passed into the duodenum. It possesses essentially the property of acting as a disinfectant on the contents of the bowel, preventing sluggish deposits. The pancreatic gland, also called sweetbread, lies in the region of the stomach, at the posterior end of the dorsal vertebræ, under the pillars of the diaphragm, and encloses with its two branches the anterior mesentery root; its structure is the same as the salivary glands of the head, and yields the pancreatic juice which is brought through the pancreatic duct to the duodenum. The function of the pancreatic juice is to solve albuminous bodies and render them capable of absorption; besides this, it is capable of splitting up fat, and also possesses in a high degree the property of changing starch into glucose.

A third large gland in the hind part of the body—which is not, however, connected with digestion—is the spleen. It is a so-called blood gland, its structure resembling the lymphatic glands. It lies against the anterior end of the left bag of the paunch, is almost triangular, squeezed flat, and possesses, besides its detachable serous covering, a true skin, known as the *propria;* it is bluish-grey in colour. It probably assists in the formation of blood, but of its particular use very little is known.

## URINARY SYSTEM.

The urinary organs are divided into the secretory organs (the kidneys) and into those bringing and conveying away the urine (Uterus, Bladder, and Urethra); with these is also reckoned a gland which has really nothing to do with the preparation of the urine—the suprarenal gland. The kidneys are a pair of bean-shaped organs, which lie under the last dorsal and first lumbar vertebræ; the right kidney lies more forward than the left. They are of a brownish or bluish-red colour, of rather firm consistency, and are enclosed in a mass of fibrous tissue, containing much fat and the renal capsules; and besides this, each kidney has an easily-detached fibrous capsule of its own. In section, two quite distinct layers may be seen—the medullary and the cortical substances. In the cortex lie the Malpighian bodies, visible to the naked eye, which form the urine-secreting portion of the kidney, while the urine is brought to the so-called kidney pelvis or basin, whence it is conducted through the uterus to the bladder. From here the urine is forced forward to the outlet of the urethra, which is connected with the sexual organs. It is the office of the kidneys themselves (in which the secretion of the constituents of the urine is continually being carried on uninterruptedly, while the discharge of it only takes place at certain intervals) to regulate the watery contents of the blood, to secrete and carry off the used-up constituents of the body, and to expel foreign matter which has found its way into the body and blood from the former. They are therefore those organs on the functions of which the normal condition and composition of the blood is primarily dependent.

## GENERATIVE SYSTEM.

The organs of generation are concerned in the development of the fœtus. They are divided into male and female. In the male organs are reckoned the testicles—the most essential organs of generation—a pair of almost oval glands, embedded in the scrotum, and which, in the sheep, are considerably developed in proportion to the size of the body. In them the spermatic fluid is formed, which is brought through the seminal canal and spermatic cord into the male organ, and thence, at the act of copulation, into the female sexual organs. There is also a row of glandular organs belonging to the male sexual organs—the accessory testicles, the spermatic vesicles, the Cowper glands, and the prostrate glands.

The female sexual organs consist of organs for the development of the ovum, the embryo, the ovaries, Fallopian tubes (the oviparous ducts), and the womb or uterus.

The udder is a large compound, grape-shaped gland, divided into two symmetrical halves, situated externally between the thighs in the regio pubis. It consists of two lacteal glands, with two outlets each, the teats, which in the sheep have a divergent direction, shaped like a sharply-pointed cone, and have but one opening. On the side surface of the udder there is, on each side, in the sheep, a pocket-shaped thickening of the usual covering, in which are highly-developed sebaceous and perspiration glands. The teats are very hairy, and the hind-teats are generally wanting. The glandular substance is greyish-red in colour, and is composed of numberless tiny gland-cells, uniting to form gland-vesicles and lobes, giving off milk as a secretion, which is brought by collecting-ducts to the milk cistern, situated at the base of the teat, whence the young suck it out. Milk is the indispensable food for the young new-born animal. Not only does it contain all the ingredients needed by the young ones for food and further development of the body (protein, carbonic-hydrates, fat, phosphites for bone-formation), but these components are easily dissolved, and remain in suspension in the milk, in a manner capable of their being absorbed in the most fitting way. Milk is a white opaque liquid, representing an emulsion of the tiniest fatty particles. Under the microscope it is clear as water, and innumerable minute globules of fat may be discerned, which, by refracting light, lend to it its white colour. These fatty globules, on account of their lighter specific gravity, rise to the surface of the milk, if it is left long standing, and form the cream or scum. In the course of a few days the milk settles into a rather firm mass, through the action of the developing lacteal acid, by secretion of a serous fluid, the whey. The secretory activity of the gland first begins in the last part of pregnancy, that is, immediately before birth, is materially assisted by the sucking of the young at the teats of the udder, and gradually ceases when the young one ceases to suck. The formation of milk only takes place during pregnancy, therefore it is necessary, in order to produce continued secretion, to exercise, by milking, an artificial irritation on the lacteal glands.

The milk-yield of the female animal depends on different factors. An increased activity is certainly peculiar to certain races and breeds, just as in the ox; but with these, also, it is principally caused by milking, *i.e.*, the continuous artificial friction of the gland, and slackens as soon as milking ceases. When not milked, the lacteal glands cease to give off more milk than is necessary for the nourishment of the young ones. Merinos, like all sheep which are kept more for their wool, have only a limited secretion of milk, sometimes hardly sufficient for the lamb; while the ewes of those races which are regularly milked —*e.g.*, the Friesland sheep—secrete a much greater quantity. Besides the above-named constituents, milk contains several extractive principles, which impart to the different kinds of milk their distinctive taste, which is a quite characteristic one in sheep-milk. Sheep milk has, as opposed to milk of the goat and cow, a larger proportion of solids, and in these again the greatest amount of albuminoids. It is also richer in fat and caseine than cow's milk. In cheese-making, sheep's milk is much employed, as in Roquefort and Aveyron, in France; in Italy, the Netherlands, East Friesland, Moravia (Brinsa cheese), Galicia, Transylvania, &c. In England sheep are not used for any purposes connected with the dairy.

# EXPLANATION OF THE PLATES.

## PLATE I.—DIVISIONS OF THE BODY OF THE SHEEP.

### HEAD.

1. Back of head.
2. Horny protuberance.
3. Horns.
4. Ears.
5. Forehead.
6. Bridge of nose.
7. Nostrils.
8. Mouth, with cleft upper lip and lower lip.
9. Chiu.
10. Throat.
11. Cheeks.
12. Eyes and eyelids.
13. Lachrymal pit.

### NECK.

14. Nape of neck.
15. Crest.
16. Throat.
17. Dewlap.

### TRUNK.

18. Withers.
19. Back.
20. Loin or kidney region.
21. Walls of chest.
22. Fore part of breast.
23. Lower breast.
24. Abdomen.
25. Flank.
26. Hungergrube.
27. Haunches.
28. Rump.
29. Croup.
30. Tail.
31. Scrotum.
32. Point of discharge from sheath or prepuce.

### FORE LIMBS.

33. Shoulder.
34. Point of shoulder.
35. Fore-arm.
36. Elbow.
37. Front-knee.
38. Shin-bone.
39. Fetlock, or fetlock-joint.
40. Pastern.
41. Coronet with the balls.
42. Hoofs.

### HIND LIMBS.

43. Upper thigh.
44. Hip-joint.
45. Back knee-joint.
46. Lower thigh.
47. Hock.
48. Heel.

From the hock downwards, the descriptions are the same as in the fore-limbs.

## PLATE II.—THE SKELETON.

### HEAD.

1. Upper jaw.
2. Lower jaw.
3. Occipital bone.
4. Frontal protuberance.
5. Horn cores.
6. Frontal bone.
7. Lachrymal bone.
8. Zygomatic bone.
9. Temporal bone.
10. Nasal bone.
11. Superior maxillary bone.
12. Upper molars and incisors.
13. Anterior maxillary bone.
14. Edge of frontal bone.
15. Orbital cavity.
16. The lower molars.
17. The eight lower incisors.

### NECK AND TRUNK.

18-24. 7 cervical vertebræ
18. The atlas, being the first.
19. The axis or rotator.
25-37. 13 dorsal vertebræ, with 1′-13′. The ribs, being 1′8′. True ribs ; 9′-13′. False ribs.
38. Sternum or breast-bone.
39-45. 7 lumbar vertebræ (often only 6).
46. The sacrum.
47-58. 12 coccygeal vertebræ. (The sheep has 3-24 coccygeal vertebræ).
59-61. Bones of the pelvis.
59. Ilium.
60. Ischium.
61. Os pubis.
62. Hip-joint.

### LIMBS.

63. Shoulder bone (*Scapula*).
64. Point of shoulder.
65. Upper arm bone (*Humerus*).
66. Elbow bone (*Ulna*).
67. Fore-arm bone (*Radius*).
68. Elbow-joint.
69. Fore knee-joint (*Carpus*), consisting of—
70. Unciform bone.
71. Polygonal bone.
72. Cuneiform bone.
73. Cuboidal bone.
74. Semi-lunar bone.
75. Scaphoid bone.
76. Metacarpal bones.
77. Sesamoid bones.
78. Pastern bones.
79. Coronet bones.
80. Hoof bones.
81. Navicular bones.
82. Upper thigh bones (*Femur*).
83. Patella.
84. Gt. lower thigh bone (*tibia*).
85. Knee-joint (*stifle*).
86. Hock, consisting of—
87. Calcis or heel-bone.
88. Astralagus.
89. Scapho-cuboid.
90. The 1st cuneiform bone.
91. The 2nd and 3rd cuneiform bones.

From the hock downwards the bones are the same as on the fore-limbs.

## PLATE III.

Abbrev.: *H.* Heart; *L.* Windpipes; *S.* Œsophagus; *L.* Liver; *M.* Stomachs. Arteries are traced in *red*, the veins in *blue*.

### A. ARTERIES.

1. Aorta or principal artery.
2. Left coronary artery of the heart.
3. Anterior aorta.
4. Posterior aorta.
5. Left inomiuate artery (section), subclavian artery.
6. Principal brachial artery (giving off right inominate artery).
7. The left carotid artery,
8. The right carotid artery, and
9. The right inomiuate (sub-clavian).
10. Branches for the windpipe, œsophagus, and neighbouring muscles; also
11. The parotid gland artery.
12. The superior thyroid artery, from which springs
13. The pharyngeal artery, which gives off branches to the thyroid gland, pharynx, œsophagus, and the larynx.
14. Origin of occipital artery.
15. External maxillary artery.
16. Internal maxillary artery.
17. Lingual artery.
    From the external maxillary artery come and are visible
18. The facial artery, with
19. Corouary artery of the upper lip, and
20. Coronary artery of the lower lip.
21. Temporal artery with its branches.
22. Lower dental artery.
23. Side artery of the nose.
24. Lower cyelid artery, and artery on bridge of nose.
    From the right inominate (9) artery come
25. Autcrior intercostal artery (section).
26. Oblique cervical artery.
27. Deep cervical artery.
28. Neck-vertebral artery.
29. Inner pectoral artery.
30. Oblique shoulder artery (not visible).
31. Outer pectoral arteries, and
32. Axillary artery (not visible).
    This last forms the continuation of the inominate artery, and gives off (not visible in Plate) the anterior scapular (shoulder) artery, the posterior shoulder artery, the lower shoulder artery, with the posterior arm-bone artery and deep brachial artery, as well as the shoulder (scapular) artery. In its further course the axillary artery is known as the brachial artery.
33. Posterior artery and fore-arm.
34. Brauches to knee.
35-36. Metacarpal arteries, and
37. Pastern bone arteries.
38. Arteries of the foot.
    (4) The posterior aorta is divided into thoracic aorta and abdominal aorta. The first-named gives off
39. Œsophagian artery.
40. Brouchial artery.
41. Ten pairs of intercostal arteries. From the abdominal aorta come
42. The lower diaphragm arteries.
43. Iliac artery, giving off the upper, middle, and lower gastric arteries and hepatic artery; also
44. Anterior mesenteric artery, which divides into two branches—the upper or iliocœcal artery, and the lower branch, the small intestine.
45. Arteries of the kidneys.
46. Internal spermatic arteries.
47. Posterior mesenteric artery.
48. The 6 (7) pairs of lumbar arteries.
49. Arteries of the thigh.
50. The two pelvic arteries.
51. The middle sacrum arteries.
    The arteries of the thigh (49) give off
52. The abdominal arteries.
53. The external spermatic artery.
54. Epigastric artery.
55. Deep artery of the upper thigh.
56. External artery of upper thigh.
57. Anterior femoral artery.
58. The iuner skin artery, with the external and iuternal hock arteries.
59. Posterior tibial artery.
60. Anterior tibial artery.
61. The fibula artery.
62. The lower part of femoral artery.
63. The metatarsal artery.
    The two pelvic arteries (54) give off
64. The umbilical artery, and thus the uteris artery.

### PLATE III.—*continued.*

65. The coccygeal arteries.
66. Gluteal arteries.
67. Obturator arteries.
68. Internal pudic artery.
69. Ischiatic arteries.
70. The pulmonary artery carrying veuous blood to the lungs.

### B.—THE VEINS.

71. The anterior Vena cava brings the blood returuiug from the front part of the body back into the right auricle. Its two principal compouents are:—
72. Jugular vein. It receives, besides, a set of smaller veius, flowing in same direction as arteries, and having similar names. It also receives from the region of the posterior aorta
73. The Great Azygos, formed by the intercostal veins and veins of the œsophagus and air passages.
74. The posterior Vena cava brings back the blood from the posterior parts of the body, and forms agaiu, together with those veins comiug from the arteries aud named after them, the veins of the sacrum, ilium, pelvis, loins, spermatic, kidneys, &c., and the
75. Veins of the liver, which convey the blood back from the capillary network system.
76. Portal system, formed in the liver by the portal vein in three or four principal branches, and several smaller ones.
77. The portal vein is composed of the posterior and anterior mesenteric and gastric veius, together with their branches.

## PLATE IV.

### THE MUSCLES.

1. Muscle of the upper lip.
2. Zygomatic muscle.
3. Elevator of the upper lip.
4. Pyramidal muscle of the nose.
5. External cheek muscle.
6. Depressor muscle of lower lip.
7. External maxillary muscle (Masseter).
8. Sterno maxillaris.
9. Its sinew, touchiug on the lower jaw.
10. Orbital cavity portion of the circular muscle of the eye-lids.
11. Its eye-lid part.
12. Upper
13. Middle } Abductor of ear.
14. Lower
15. Muscle of parotid gland.
16. Neck part
17. Sinewy part } of muscles common to head, neck, and arm.
18. Arm part
19. Subclavian ligament.
20. Part of the sterno maxillary muscle.
21. Superficial or broad pectoral muscle.
22. Posterior and
23. Anterior parts } of the elevator muscle of the shoulder.
24. Lower elevator of the shoulder-bone.
25. Trapezius.
26. Its sinew.
27. Posterior part } of long brachial ex-
28. Auterior part } tensor.
29. External
30. Thick } Extensors of fore-arm.
31. Long
32. Broad dorsal muscle.
33. External oblique abdominal muscle.
34. Broad-toothed muscle (serratus magnus).
35. Deep or large pectoral muscle.
36. Extensor of shin-bone.
37. Extensor of inner claw (digit ?).
38. Common extensor of digits.
39. Extensor of external digit.
40. External (flexor ?) of (tarsus ?) of fore-foot.
41. Oblique extensor of ditto.
42. Superficial flexor of foot.
43. Its sinew.
44. Deep flexor of foot.
45. Its sinew.
46. Siuews connecting the above-meutioned portions.

### PLATE IV.—*continued.*

47. Sinew of extensor of middle of fore-foot.
48. Oblique extensor of tarsus of fore-foot.
49. Pastern bone flexor.
50. Sinew of extensor of inner digit.
51. Oblique ligaments.
52. Gluteus.
53. Tensor muscle.
54. Rectus femoris.
55. Anterior (large) head of abductor of hind-leg.
56. Posterior (small) head of ditto.
57. Long abductor of hind-leg.
58. Thick ,, ,,
59. Muscle drawing the tail to one side.
60. Flexor of metacarpus bone.
61. Long exteusor of foot.
62. Peroneus.
63. ,,
64. Long flexor of foot.
65. External fibula muscle.
66. Internal ,, ,,
67. Extensor muscle.
68. Teudon Achilles.

## PLATE V.—VERTICAL SECTION OF THE BODY.

1. Cerebrum.
2. Cerebellum.
3. Pons varolii.
4. Medulla oblongata.
5. Spinal marrow.
6. Oblique section of cervical, dorsal, lumbar, sacral, and coccygeal vertebræ.
7. Ligament nuchæ.
8. Turbinated bones.
9. Pharynx.
10. Entrance of the larynx.
11. Trachea.
12. Thyroid gland.
13. Bronchi aud their branches.
14. Left lung.
15. Right lung.
16. Wall of pectoral cavity from inside.
17. Diaphragm (tendinous or sinewy portion).
18. Diaphragm (muscular part).
19. Left (arterial) ventricle from outside, and left auricle above it.
20. Right (venous) ventricle from without, and right auricle above it.
21. Pulmonary artery, coming from the right ventricle.
22. Aorta, coming from the left ventricle.
23. Interior of right auricle.
24. Interior of right ventricle.
25. Interior of left auricle.
26. Interior of left ventricle.
27. Chordæ, tendinæ of the mitral valves in left and right ventricles.
28. Cavity of the mouth, with molars.
29. Tongue.
30. Palate and palatal ridges.
31. Pharynx.
32. Cervical and pectoral portion of œsophagus. After piercing the diaphragm, it enters
33. The first stomach (paunch).
34. Its left or upper bag.
35. Its right or lower bag.
36. Bands of the paunch.
37. Paunch.

### PLATE V.—VERTICAL SECTION OF THE BODY—*continued.*

38. Opening of œsophagus and its insertion (*Cardia*).
39. Front
40. Middle } divisions of the paunch.
41. Back
42. Spleen.
43. Opening into the second stomach.
44. Second stomach (*Reticulum*).
45. Its meshes or cells.
46. Third stomach (*Omasum*, leaved tripe).
47. Its leaves.
48. Fourth stomach (*Abomasum*).
49. Its folds of mucous membrane.
50. Pylorus or portal (passage into intestinal canal).
51. Duodenum.
52. Mesentery.
53. Jejunum.
54. Ilium.
55. Its discharging into cæcum.
56. Cæcum.
57. Colon.
58. Rectum.
59. Anus.
60. Liver (drawn at the back of the diaphragm).
61. Its right
62. Its left } lobes.
63. Its 4-sided
64. Gall-bladder.
65. Biliary ducts of liver.
66. Biliary duct of bladder.
67. Common biliary duct, going to duodenum.
68. Right and left broad ligaments of liver.
69. Left kidney.
70. Section of this with kidney pelvis.
71. Right kiduey.
72. Ureter, coming out of the kidney pelvis, aud leading to the
73. Bladder.
74. Neck of bladder.
75. Vent-opening of bladder in the
76. Urethra in the penis.
77. Scrotum.
78. Spermatic duct.
79. Abdominal cavity.
80. Pelvic cavity.

In studying Plate V., push 14 upwards, 19 to the right, 20 to the left; then lay them together again and bend heart and right lung upwards to show the pectoral cavity. Laying the lung flat again, bend the left half of diaphragm (17, 18) to the left, to expose the first stomach (33) with the spleen (42). The first-named opens upward, and after examination of its inner walls, it may be folded to the right, so as to show the second, third, and fourth stomachs with their inner linings (44, 46, 48). Then lay these, together with the first portion of the duodeuum, to the left. Bend downwards the then visible mesentery (52), with the jejunum (53), the ilium (54), the colon (57), and rectum (58), thus laying bare the cæcum (56) and discharging end of ilium (55). The left kidney is shown iu sectiou (69), and pushed up while bending the cæcum round to the right to show the ureter (72). The other organs of the abdominal and pelvic cavities, such as the liver (60), bladder (73), right kidney (71), scrotum (77) and its excretory passages, are drawn on the flat in the plates. Then, in reversed order, the different parts are replaced in position, Plate IV. on Plate V., and Plate II. on Plate III., so that Plate I. again resumes its positiou on the top.



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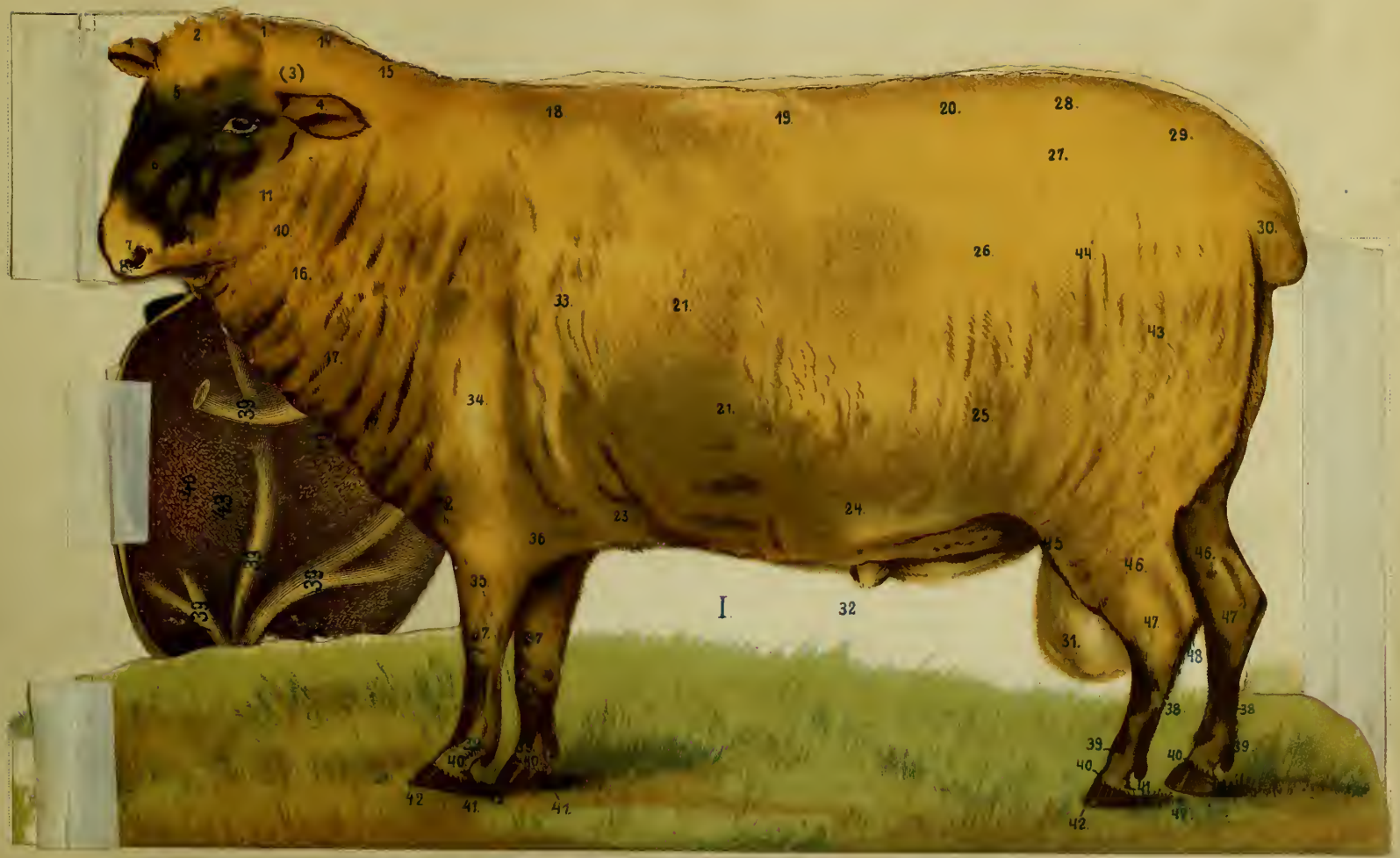
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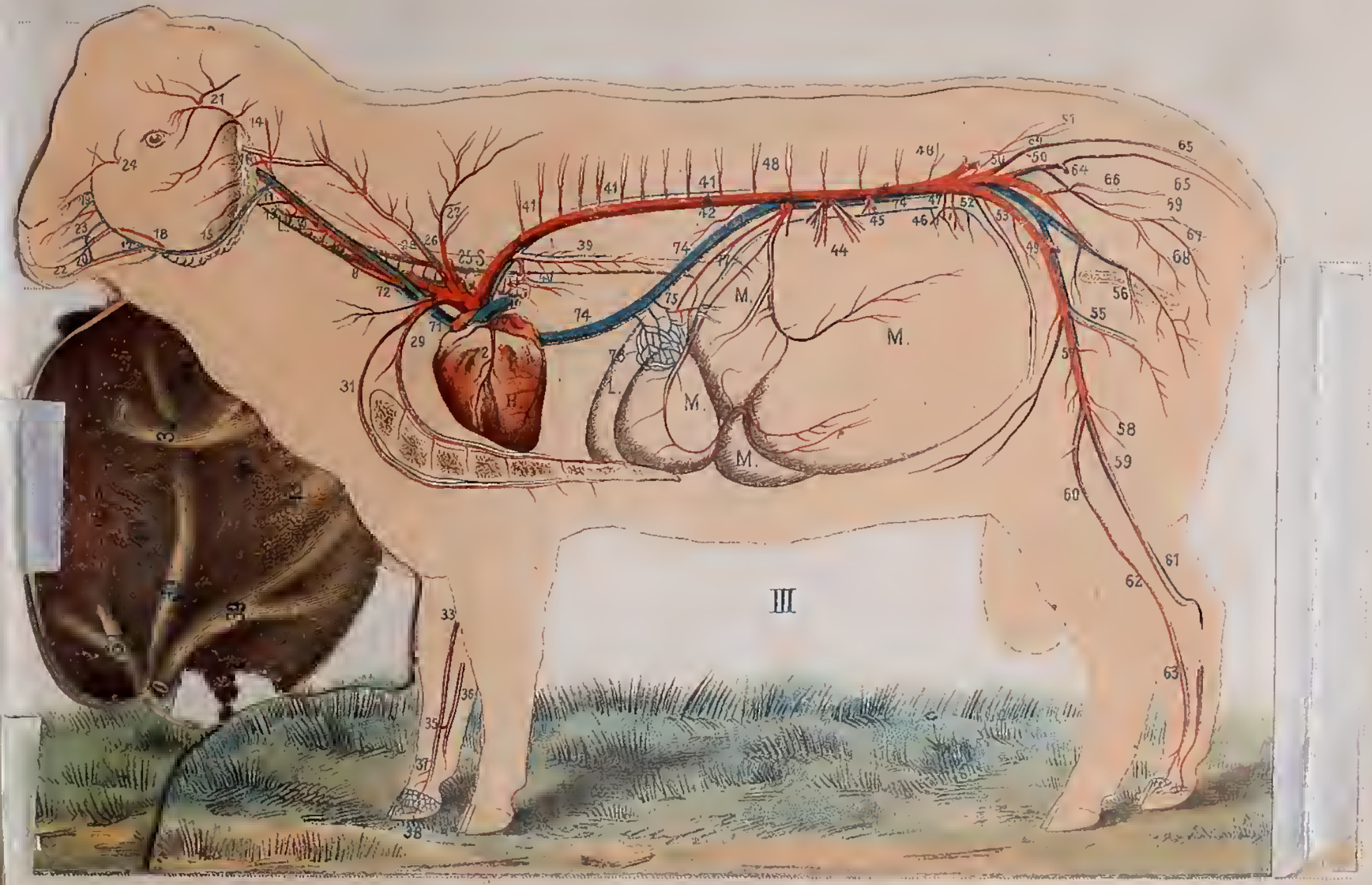
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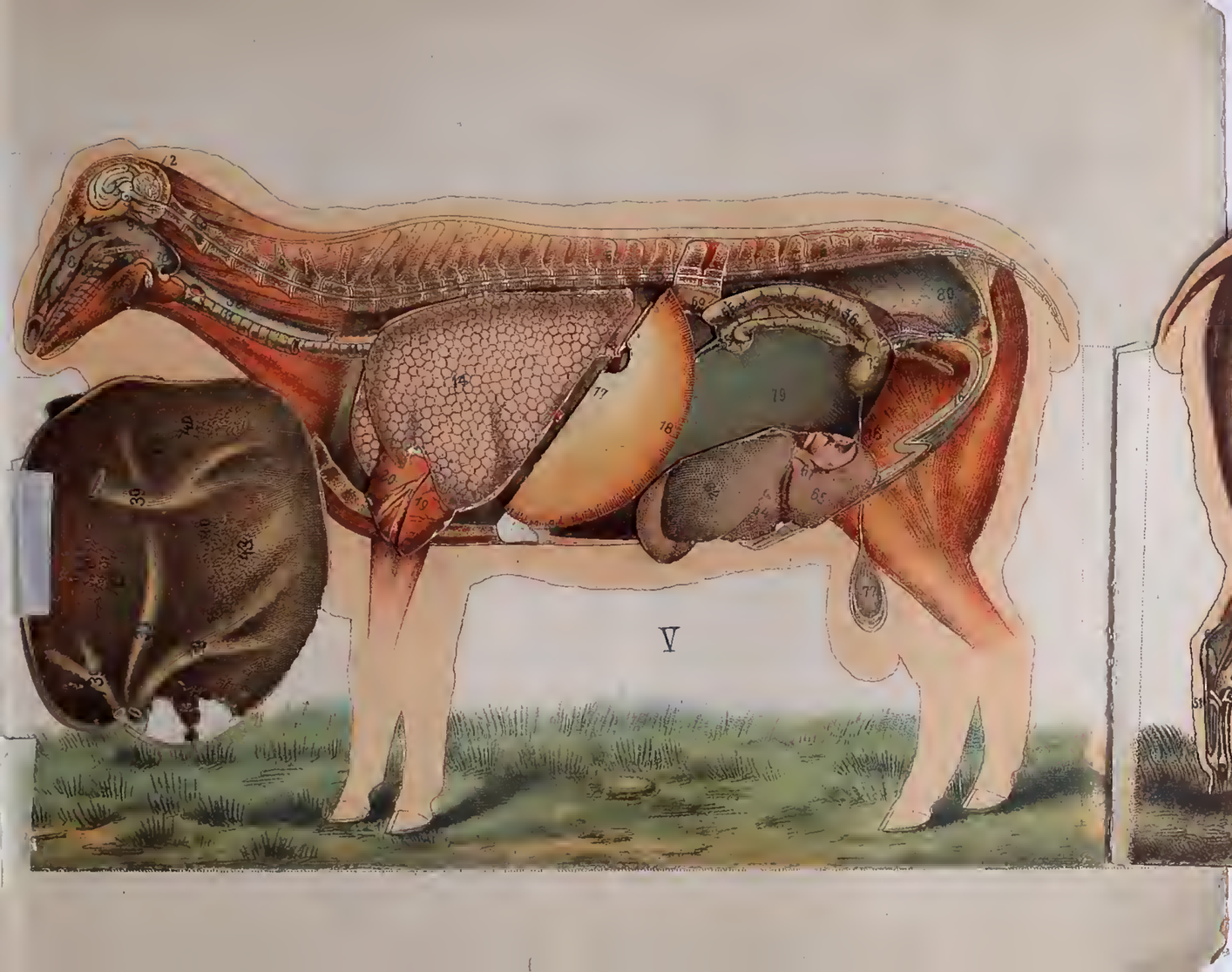
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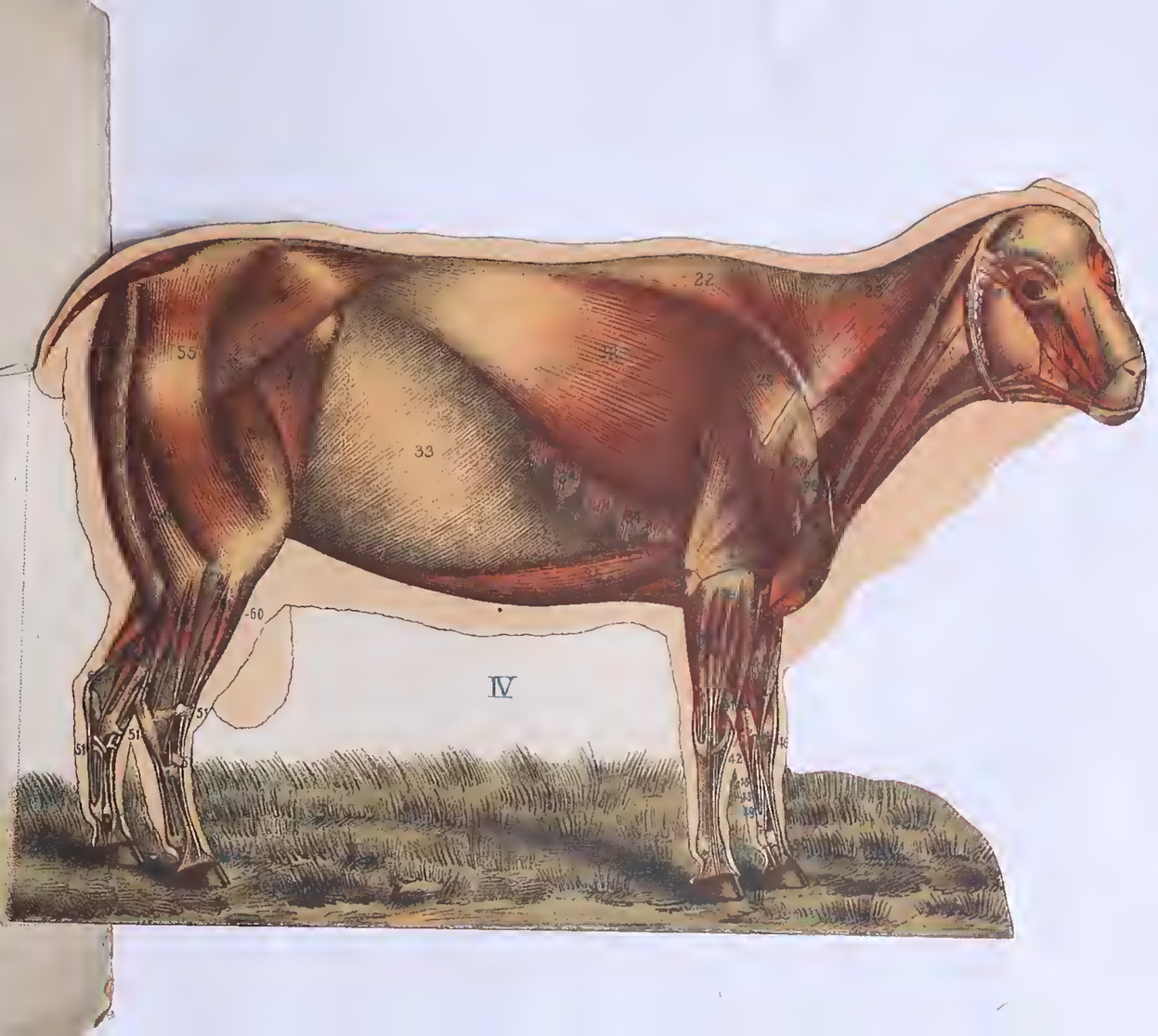
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